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MINERALOGY AND PETROGRAPHY.[1]

THE CLASSIFICATION OF NATURAL SILICATES.[2]—The author discussed the history of mineralogy, and noticed the method of classifying mineral species based solely on physical characters, which makes mineralogy a division of natural history. He then proceeded to consider the method of those who have arranged mineral species in accordance with the results of chemical analysis, disregarding or giving a subordinate place to physical characters. A true philosophy, it was contended, should keep in view both of these methods; the chemical cannot be separated from the physical study of species, and a thorough knowledge of the chemical constitution of these will show that their physical characters are intimately related thereto, and will lead to a natural system in mineralogy.

The author, in attempting the elaboration of such a system, begins by showing, in the present paper, its application to natural silicates. These he regards as polysilicates of high equivalent weights, in accordance with the view put forward by him in 1853, when wollastonite was referred to a polysilicic acid with $11SiO_2$, and pyroxene to one with $14SiO_2$, or some simple multiple of these numbers. In such compounds the degree of complexity of the molecule is shown by the relation to space of the chemical equivalent or, in other words, by its volume. To arrive at a term of comparison for this in species of various and unknown degrees of complexity the author deduces for each silicate the mean equivalent weight of its atomic unit, corresponding to an atom of NaCl, for which purpose H_2O and CaO are divided by two, SiO_2 by four, and Al_2O_3 by six. The mean unit-weight, P, thus deduced from any arbitrary chemical formula, divided by the specific gravity of the species, gives the volume of the unit V, which serves to show for different species the relative condensation of the molecule. The hardness and the chemical relations of species will be found to vary with the unit-volume.

For example, the simplest atomic ratio representing the two species meionite and zoisite (which have the same centesimal composition), is (ca.al2.si3) o6; the small letters representing atoms, and $o = 8$. This gives an equivalent of 107, which divided by six yields for the mean atomic weight of the unit in both of these species $P = 17.83$. Dividing this latter number by 2.7, as the specific gravity of meionite, we have for the atomic volume in this species $V = 6.60$, and by 3.4, as the specific gravity of zoisite, $V = 5.24$. The true formulas and equivalent weights of these polysilicates must be deduced from a comparison of their specific gravities with those of species whose equivalent weights are otherwise determined. Meanwhile it will be seen that zoisite, with the lower value of V or, in other words, the more condensed molecule, differs from the less condensed meionite by its greater hardness and its superior resistance to the action of acids.

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[1] Edited by Dr. GEO. H. WILLIAMS, of the Johns Hopkins University, Baltimore.

[2] Abstract of a paper read before the Nat. Acad. Sciences, April 21, 1885.

From a consideration of the constitution thus assigned to silicates, it follows that the comparatively simple ratios generally deduced for the silica and the various bases are, in many cases, but approximations to the more complex ratios really existing. These, from the frequent impurities of natural silicates, can seldom be fixed with exactness, though with sufficient precision to give very nearly the values of P and V, which latter serves to determine the place of the species in the natural system of classification.

Water being an element universally distributed, its presence or absence in a silicate becomes of subordinate importance in determining alike the genesis and the natural affinities of species, so that the water-ratios are omitted in the tables of classification (which were shown), wherein the various natural silicates are, from the chemical side, considered with regard to the atomic ratios of fixed bases to each other and to the silica. There are genetic reasons for separating silicates of sesquioxyd bases, like alumina from protoxyd-silicates. The former of these constitute the class of Persilicates, and the latter the Protosilicates; those containing both protoxyds and sesquioxyds being designated Protopersilicates. Ferric oxyd and zirconia are classed with alumina as sesquioxyds, while titanic and boric oxyds in silicates are counted with the silica in determining the atomic ratios.

In the table of the Protosilicates, and in that of the Persilicates, both hydrous and anhydrous, the generally accepted ratios of the fixed bases to the silica are noted, but in that of the Protopersilicates regard is had to the more important ratios of sesquioxyds and fixed peroxyds to each other, inasmuch as the ratio of silica to both of these is found to vary greatly in closely related species, as may be seen in zeolites, feldspars, scapolites and micas. In these tables the three great classes of silicates are each arranged in groups, with primary reference to physical characters. Thus for Protosilicates we have in parallel columns, Pectolitoid, Spathoid, Adamantoid and Ophitoid, with each of which the range of values for V is given, while in an adjacent column to the left are inscribed the approximate atomic ratios of fixed protoxyds to silica. Among pectolitoids are included with pectolite, apophyllite and datolite, hydrohodonite, pyrosmalite, dioptase, calamine, cerite, thorite, etc. The spathoids embrace willemite, tephroite, gadolinite, helvite, leucophanite, wollastonite and tscheffkinite; the adamantoids, chondrodite, chrysolite, phenacite, bertrandite, hornblende, pyroxene, titanite, and danburite, while the ophitoids include various hydrous silicates, of which villarsite, serpentine and talc are representatives.

The Protopersilicates, in like manner, are grouped under the heads of Zeolitoid, Spathoid, Adamantoid and Phylloid, a subordinate division to the latter being designated Pinitoid. In a column to the left are given the atomic ratios of sesquioxyds and fixed peroxyds, the silica being variable. The zeolitoids include besides the zeolites proper, forestite, prehnite, catapleiite, etc. Under the spathoids of this class are placed petalite, all feldspars and feldspathides, including iolite and sodalite, the scapolites, barylite, milarite, gehlenite, sarcolite, melilite, wöhlerite and eudialyte. The adamantoids include keilhauite, schorlomite, ilvaite, idocrase, garnet, allanite, beryl, euclase, ardennite, axinite, epidote, zoisite, jadeite, spodumene, sapphirine, staurolite and the various tourmalines. In the phylloids are included the whole of the micas from phlogopite and biotite, through seybertite, chloritoid, lepidolite and margarite to damourite and the muscovites. With the phylloids, and near the magnesian micas, come the various chlorites, while parallel with the non-magnesian or muscovite micas are placed the pinitoids, including besides pinite, or geïseckite, jollyte, fahlunite, bravaïsite, cossaite, gümbellite, etc.

The Persilicates are all gathered in two columns under the heads of Kaolinoid and Adamantoid, the received ratios of the fixed bases and silica being given in an adjacent column. The kaolinoids include the various hydrous silicates of alumina from the highly basic schrötterite, through kaolinite and halloysite, to to cimolite and smectite. With these are placed chloropal and also pyrophyllite. The adamantoid persilicates include besides dumortierite, fibrolite, cyanite and bucholzite, andalusite, topaz, the zircons and anthosiderite.

The relations of fluorine in silicates like topaz and chrondrodite, of chlorine in scapolites and sodalite; and of sulphur in lapis-lazuli, helvite and danalite are discussed at length by the author. Tables showing the values of P and V, together with the simplest atomic formulas deduced from chemical analysis are given for most well known silicates. The discussion of the equivalent weights of these species, and their definite place in a chemical classification of polysilicates is noticed, but is left for future consideration.

If we regard the silicates as constituting a natural order, the three groups already noticed may be called suborders; A. Protosilicates; B. Protopersilicates; C. Persilicates. The divisions of these designated Pectolitoid, Zeolitoid, Spathoid, Adamantoid, Phylloid, Ophitoid, etc., will constitute tribes. The tribal characters of the spathoids and the adamantoids being repeated in the suborders, we have A. and B. Spathoids and A. B. and C. Adamantoids. The subdivisions of these tribes into families, genera and species cannot here be discussed. The genus feldspar, including anorthite, albite and perhaps iolite, with other genera, some of which are represented respectively by orthoclase, by leucite, and by sodalite, will constitute the family of the feldspathides. The families of the micas and the pyroxenides in like manner will each include several genera, having different values for V.

The application of the principles above defined to carbonates, and the reference of the various carbon-spars to different polycarbonates, was long ago shown by the author in his papers already noticed. The extension of like views to all liquid and solid inorganic species, both natural and artificial, is but a matter of detail and labor, and when fully carried out will be the basis of a new chemistry.—*T. Sterry Hunt.*

MINERALOGICAL NEWS.—Dr. Carl Hintze contributes a paper on the chemical significance of crystallography, an address delivered on the occasion of his installment as "privatdocent" at the University of Bonn.[1]——F. Rinne[2] has investigated the crystallography of zincite on some artificial crystals from the zinc-furnaces of Lerbach in the Hartz, and finds the system hexagonal and axial ratio 1 : 1.621934. On the ground of etched figures produced by cold dilute hydrochloric acid as well as from the habit of the crystals, the author assumes that the mineral is hemimorphic with a decided resemblance to wurtzite.——Dr. Schuster,[3] of Vienna, describes an occurrence of fichtelite from a new locality—Salzendeich. It is found in monoclinic crystals 1½^{cm} in length. Twins are not uncommon, the twinning plane being the basal pinacoid.——H. A. Miers[4] gives a valuable monograph on the species bournonite, in which he adds to the list of fifty forms observed by former authors twenty-nine new ones of undoubted character, while twenty-one others are mentioned as doubtful. The same writer finds the hexoctahedron $\frac{3}{2}O\frac{9}{8}$ (986) on certain cuprite crystals from Cornwall, Eng., developed in accordance with the gyroidal hemihedrism of the regular system.[5] This has before only been once observed on artificial crystals of sal ammoniac by Tschermak.[6]——L. McCay[7] proves both by analysis and determination of specific gravity that a massive as well as a crystallized variety of safflorite (Co, Fe) As_2 occurs in nature. The specimens which he examined were from Schneeberg, in Saxony, where this substance is called by the miners "schlackenkobalt." ——Messrs. Diller and Clarke[8] give the results of a microscopic and chemical study of the change of the topaz occurring at Stoneham, Me., to damourite. The alteration takes place along cracks in the topaz crystal, the transition, however, from the one mineral to the other being always abrupt. No intermediate product was observed. Professor Clarke appends some simple looking structural formulæ for certain silicate minerals which are most interesting if demonstrable.—Tiffany & Co., of New York, have just published an illustrated catalogue of their collection of rough diamonds which so admirably exhibits all the phases in the crystallography of this interesting mineral. The collection embraces 904 stones weighing over 1876 karats, of these twenty-two are in the rock.——Dr. Konrad Oebbeke,[1] of Munich, has published some studies made upon crystallized minerals found in the andesites of Mt. Dore in Central France. Hypersthene, hornblende and pseudo-brookite receive especial attention.——K. von Chrustschoff,[2] in the second part of his paper on secondary glass-inclusions finds that those observed in quartz fragments which have been imbedded in a liquid magma are due in all cases either to the infiltration of this magma into fissures or to the melting of some more easily fusible mineral which existed as an inclusion in the quartz before its imprisonment in the magma.——Professor Roland Irving, of Madison, Wis., in charge of the U. S. Geological Survey of the Archæan rocks of the Northwest, has just issued a most interesting paper on secondary enlargements of mineral fragments in certain rocks.[3] A large number of observations show the widespread growth of rounded quartz grains by subsequent deposits of silica, which acts as their cement. This phenomenon, which was first described by Sorby and has since received considerable attention from A. A. Young, Irving, and others, plays a most important rôle in the change of sandstones to quartzites. The enlargement in the same manner of feldspar grains by secondary deposits of feldspar substance was recently observed for the first time by Professor C. A. Vanhise, of Madison, whose paper is appended to the present work. The facts described are illustrated by a large number of excellent colored plates.

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[1] Ueber die Bedeutung krystallographischer Forschung für die Chemie. Habilitationsrede. Bonn, 1884.

[2] Neues Jahrbuch für Min., etc., 1884, II, p. 164.

[3] Ischermak's Min. und Pet. Mitth., II, 1885, p. 88.

[4] Mineralogical Magazine, VI. p. 69, 1884.

[5] Am. Journ. Science, 1885, May, p. 420.

[6] Tschermak's Min. und Petr. Mitth., 1881, p. 331.

[7] Am. Jour. Science, 1885, May, p. 369.

[8] Am. Jour. Science, May, 1885, p. 378.

BOTANY.[4]

Branching of Pteris aquilina.—Much has been written on the structure of this well-known fern, but the relation of the fibro-vascular system of the stipe to that of the rhizome does not seem to have been traced. The widely-creeping rhizome *A* contains at the center two strong bands of sclerenchyma with two fibro-vascular bundles or rows of bundles between them, the whole surrounded by a ring of bundles much as in Fig. 1 *B*. In branching division occurs on a line crossing both bands of sclerenchyma, setting off to the branch a portion of both central bundles

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[1] Bull. Soc. min. de France, 1885.

[2] Tschermak's Min. und Pet. Mitth., VIS, 1885, p. 64.

[3] Bulletin of the U. S. Geol. Survey, No. 8. Washington, Govt. printing office. 1884. (Price ten cents.)

[4] Edited by Professor Charles E. Bessey, Lincoln, Nebraska.